

# The Lake Michigan Ozone Study LMOS 2017

LADCO Air Directors Briefing  
May 4, 2017

Kohler-Andrae State Park, Sheboygan WI

Acknowledgement:

Brad Pierce-NOAA, Tim Bertram-U of W, and Charlie Stanier-U of I

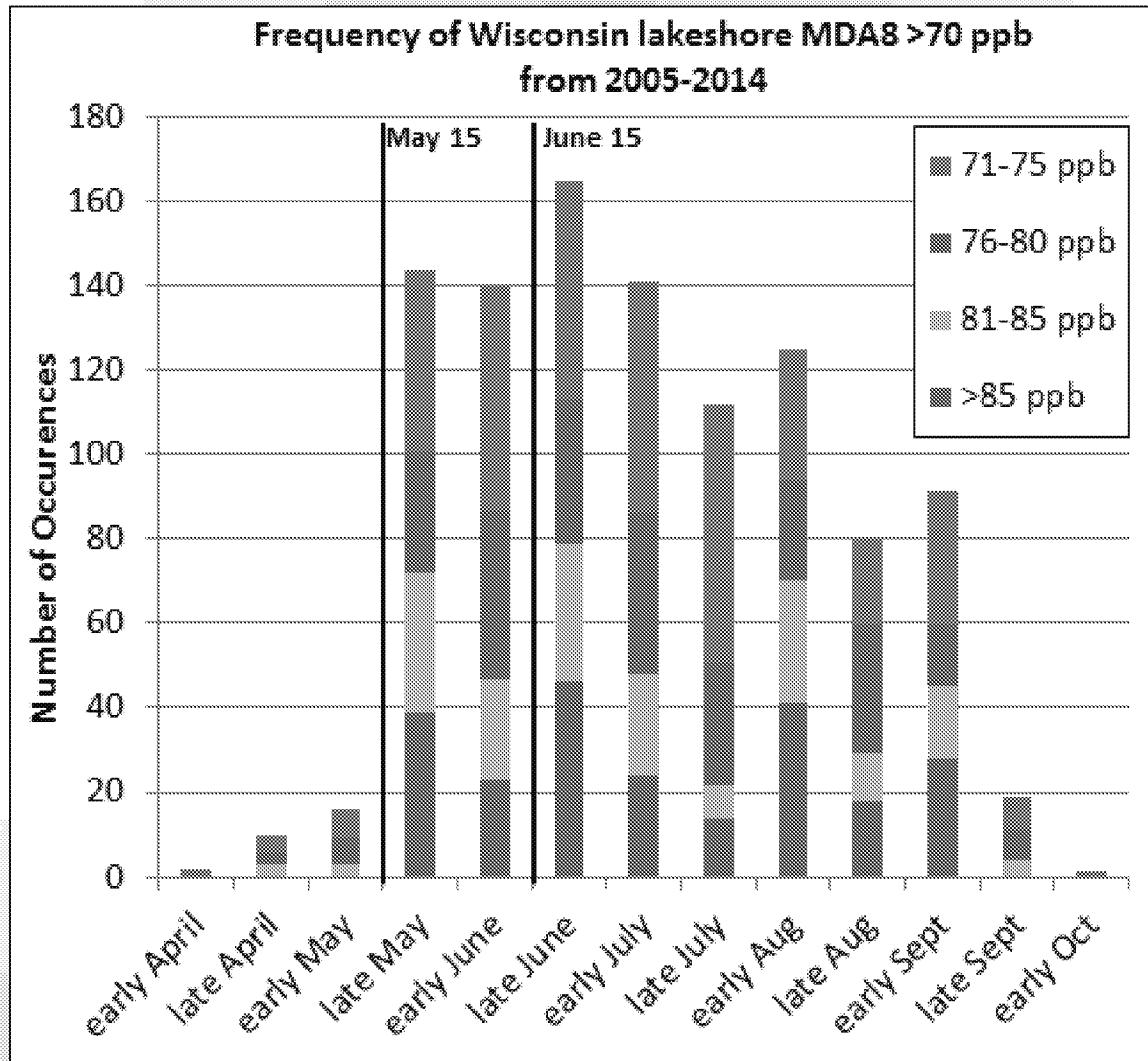
# \*Science Objectives

- \*Determine the concentrations / speciation / variability in VOCs, NOx, and VOC and their relationships to coastal ozone episodes using multiple observation-based methods.
- \*Determine the relative influences of urban plumes, localized emissions, biogenics, and transport.
- \*Evaluate chemical transport model skill for predicting ozone, VOC and NO<sub>x</sub> including the spatial and vertical distribution.
- \*To what extent do lake breeze circulations effect ozone?
- \*Evaluate coastal vs. inland ozone concentration differences.

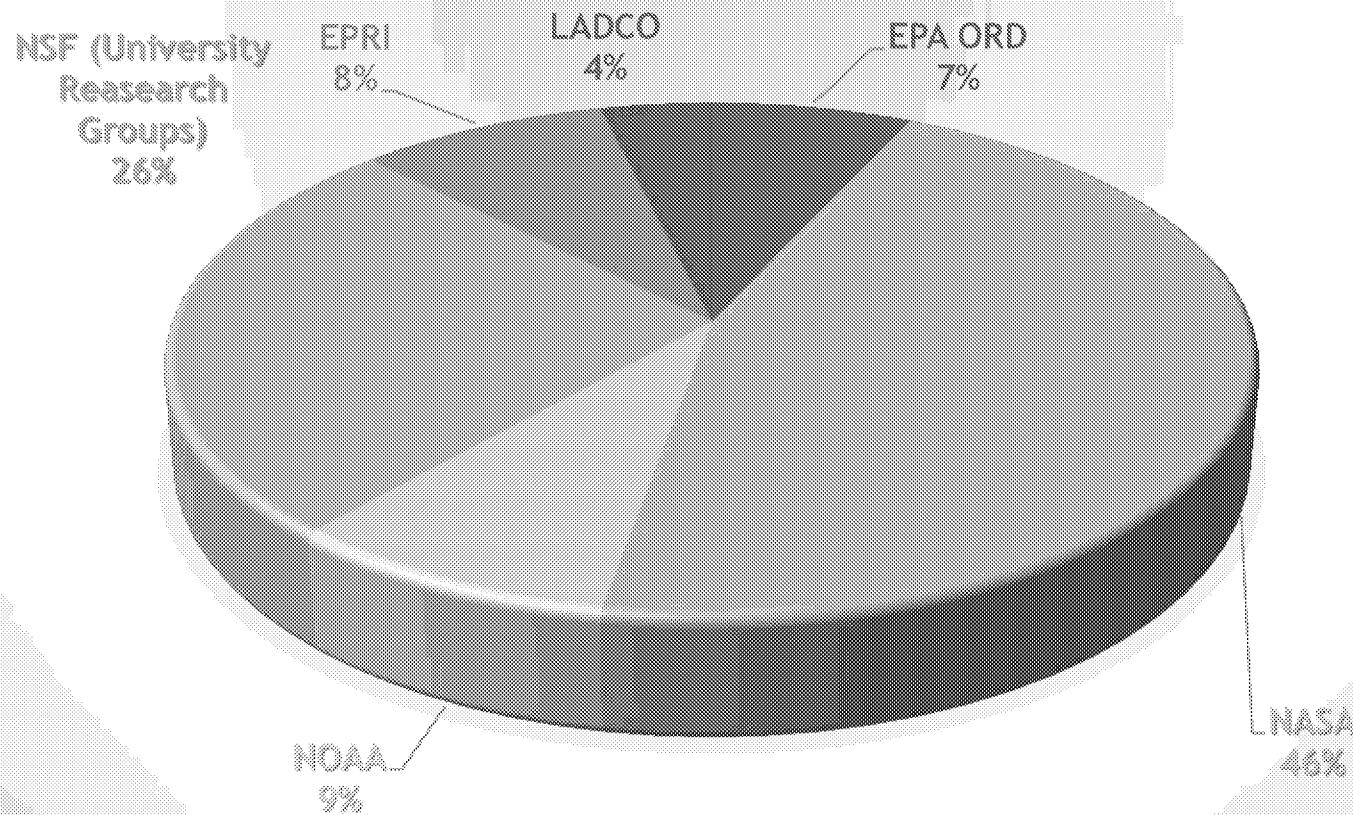
# \*LMOS 2017 - Steering Committee

- \*Brad Pierce - NOAA
- \*Tim Bertram - University of Wisconsin
- \*Charles Stanier - University of Iowa
- \*Alan Czarnetzki - University of Northern Iowa
- \*Dylan Millet - University of Minnesota
- \*Jassim (Jay) Al-Saadi - NASA
- \*Jim Szykman - NASA
- \*Angela Dickens - Wisconsin DNR
- \*Donna Kenski - LADCO
- \*Rob Kaleel - LADCO

# LMOS 2017 Study Period - May 22- June 22, 2017



# Resources Committed to LMOS 2017 - \$1.3 M\*



\*Does not include FTE or travel cost from participating Federal Agencies.

# LMOS Measurement Suite

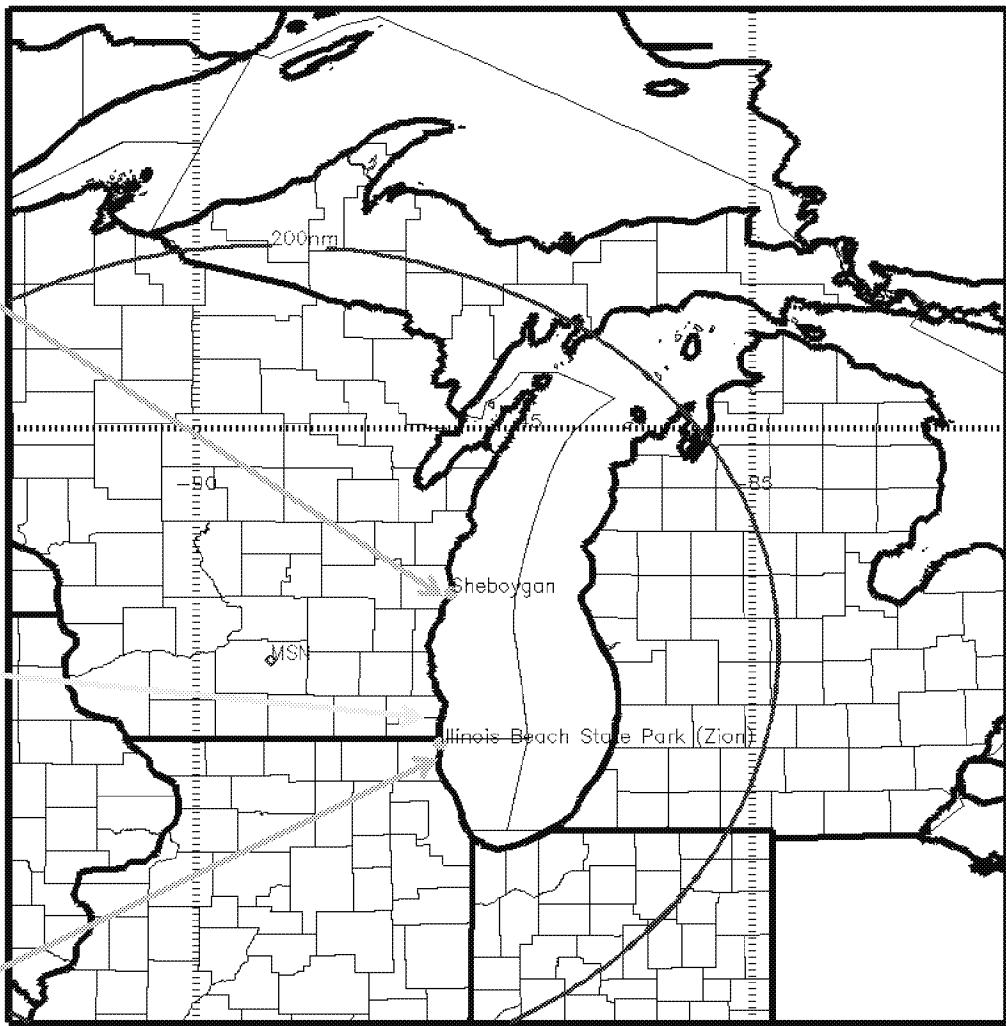
## SHEBOYGAN

- U of W SPARC Trailer (Wind Lidar, Radiometer T/Q profiles, aerosol extinction, aerosol optical depth),
- EPA Trailer (O<sub>3</sub>, NO<sub>x</sub>, HCHO)
- EPA Pandora (Column O<sub>3</sub>, NO<sub>2</sub>, HCHO)
- WDNR (O<sub>3</sub>, NO<sub>x</sub>)
- NOAA Ship (EPA Pandora, ceilometer, O<sub>3</sub>, tethered kite)
- EPRI Aircraft (O<sub>3</sub>, NO<sub>2</sub>)

EPA Geospatial Measurement of Air Pollution (GMAP) mobile van (O<sub>3</sub>)

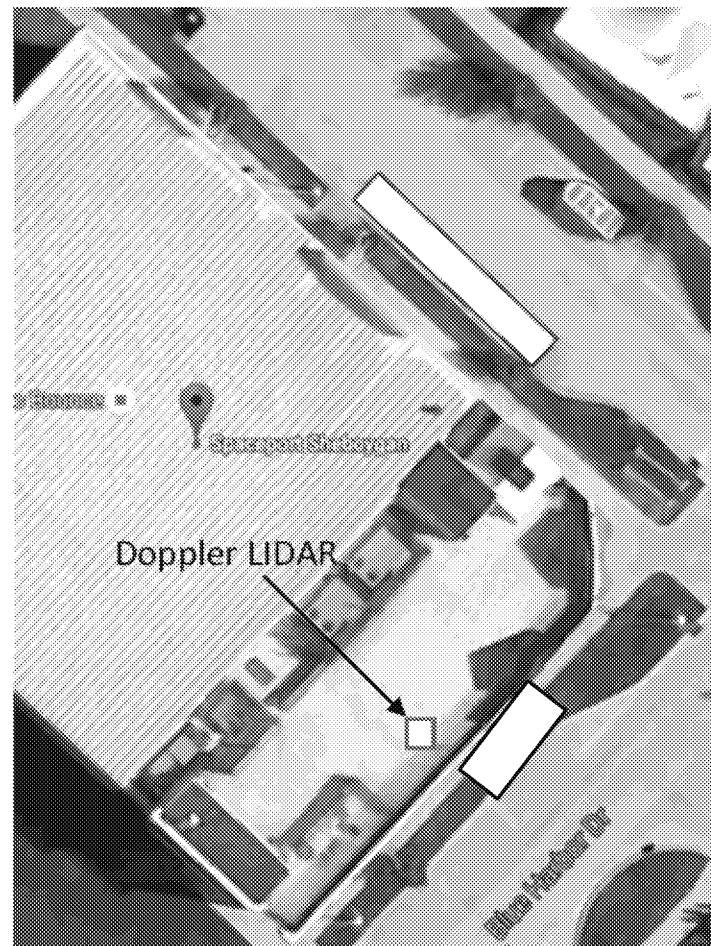
## ZION

- U of NI (Radiometer T/Q profiles, SoDAR winds)
- EPA Pandora (Column O<sub>3</sub>, NO<sub>2</sub>, HCHO)
- UW-Madison/U of MN (NO<sub>y</sub>/VOC)
- U-Iowa (Aerosol)
- IEPA (ozone, met)

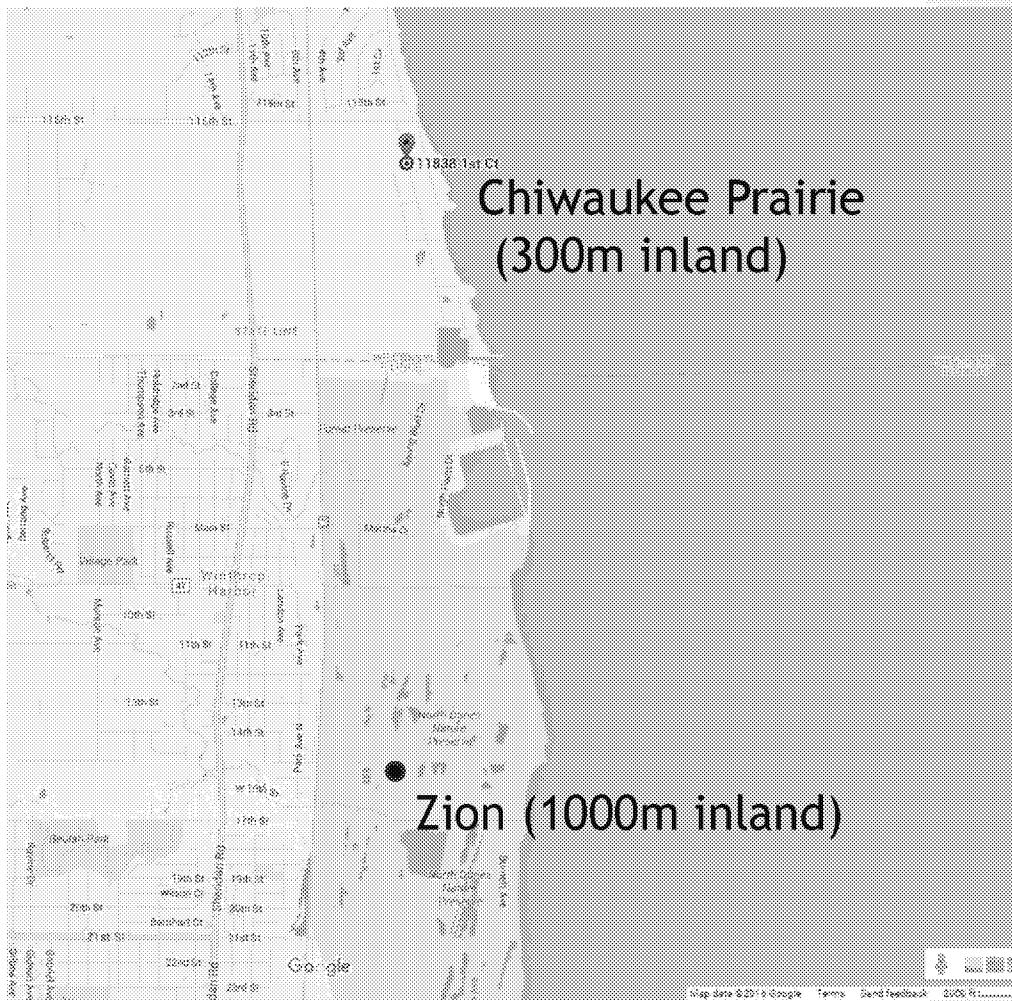
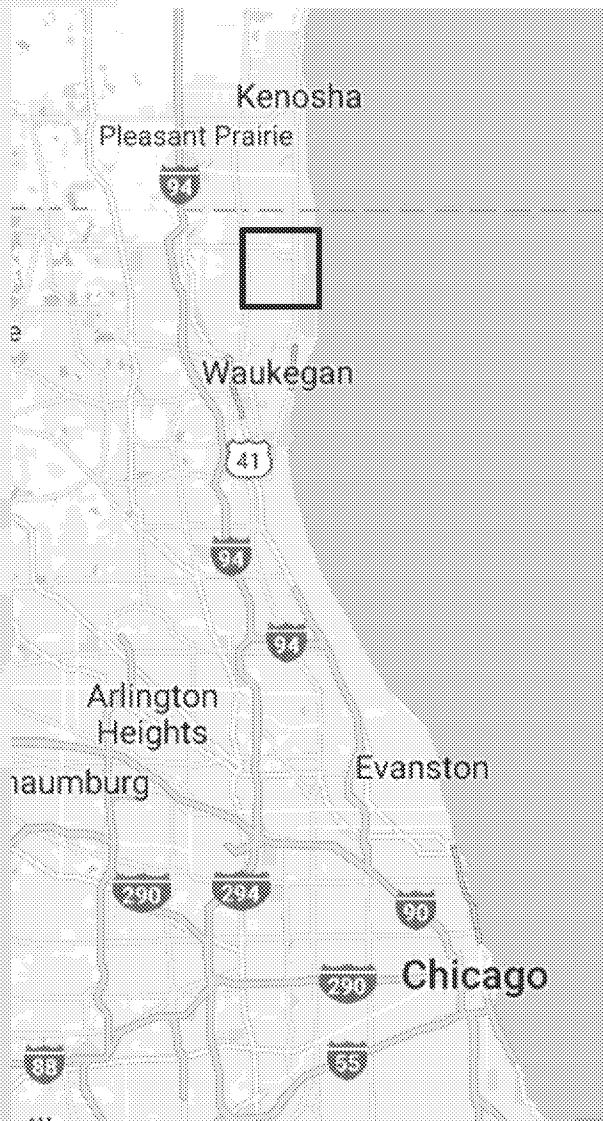


NASA Aircraft (column NO<sub>2</sub>, HCHO, O<sub>3</sub>, and aerosols, airborne UV-VIS spectrometer, Polarimeter)

# Sheboygan Supersite: Spaceport Sheboygan



# Illinois Beach State Park (Zion) Supersite

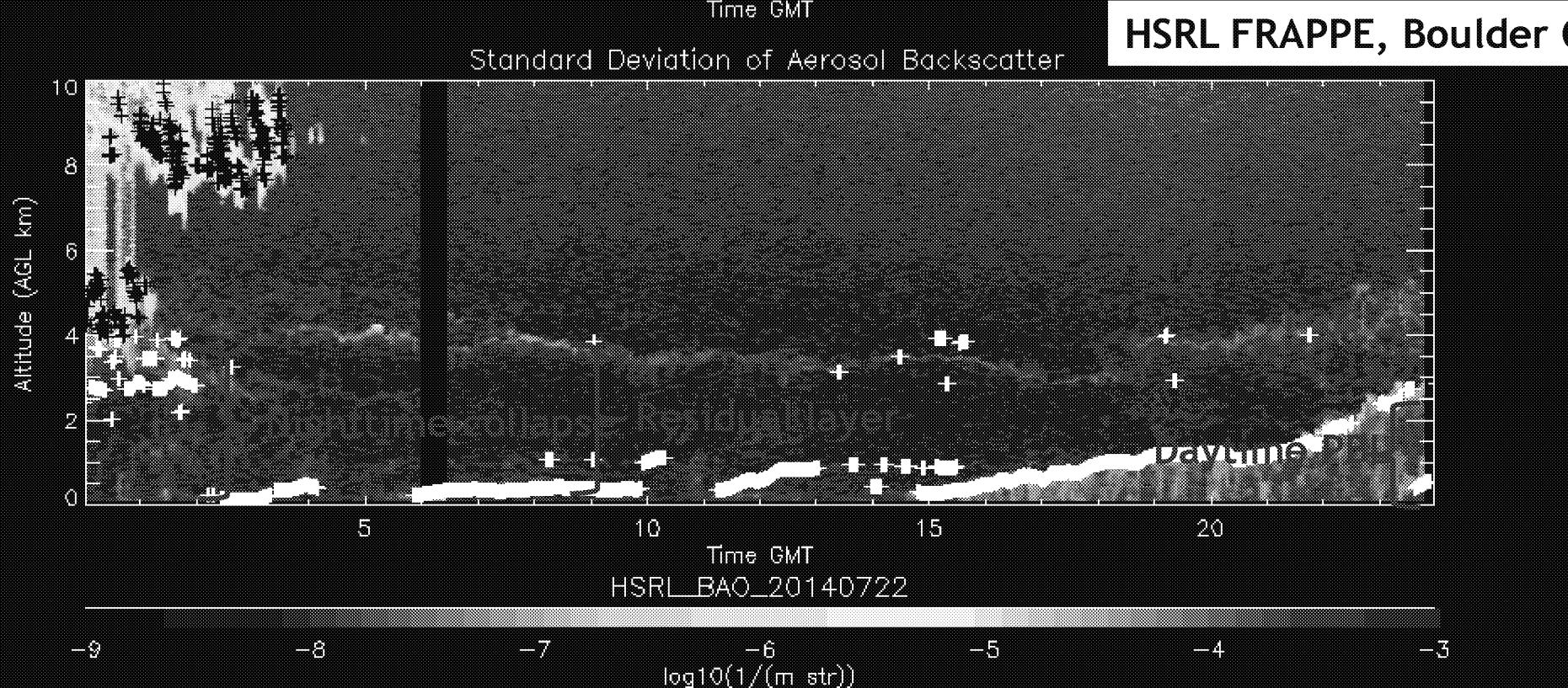
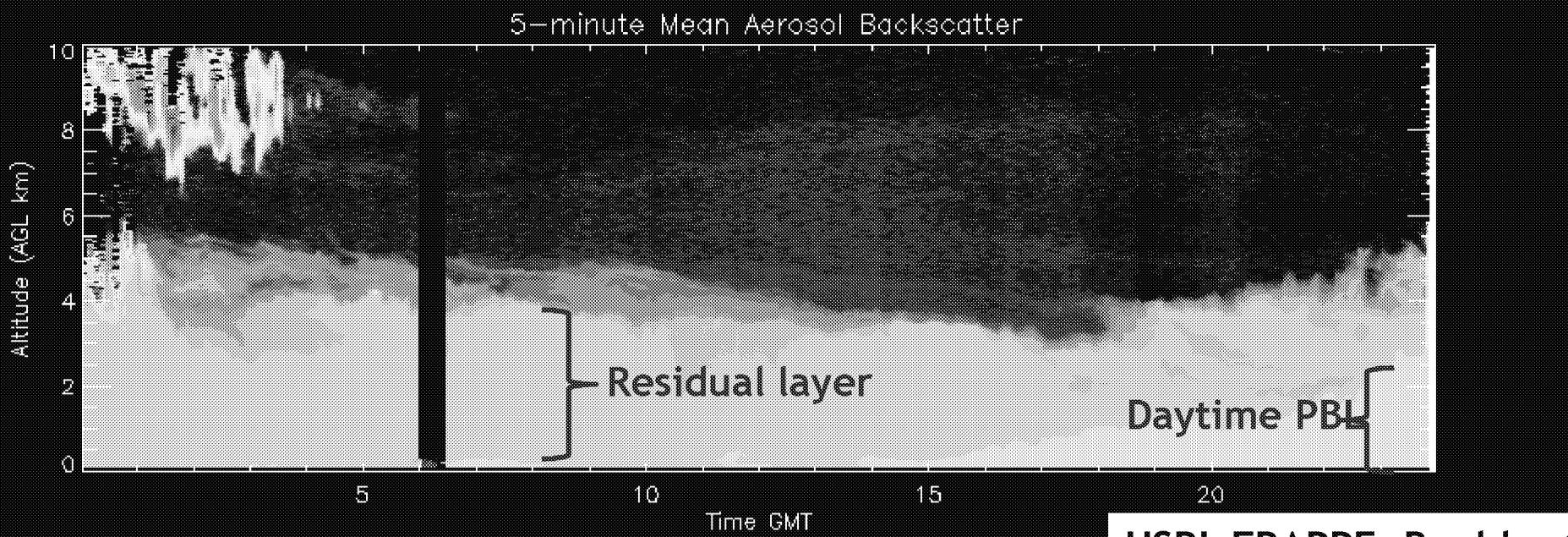


# Sheboygan: Spaceport Sheboygan UW-Madison SPARC Trailer

- **Boundary Layer Meteorology/Surface Meteorology** Tim Wagner, Univ. of Wisconsin. SPARC: the SSEC Portable Atmospheric Research Center (funded by NOAA)
  - *Profiles:* ( $T$ ,  $Q$ , wind, extinction) Atmospheric Emitted Radiance Interferometer (AERI), HSRL Lidar, Doppler lidar wind profiler.
  - *In situ meteorology:* Vaisala T, RH, pressure, wind speed, wind direction, precipitation.



The SSEC Portable Atmospheric Research Center (SPARC) during the Front Range Air Pollution Experiment (FRAPPE).



# Sheboygan: Spaceport Sheboygan EPA Research Trailer

Surface-based measurements of Trace Gases

- NOx/NOy
- O<sub>3</sub>
- HCHO



EPA Trailer at Logan, Utah January 2017

# Ship measurements: NOAA -GLERL Lake Michigan Field Station Research Vessel R5503

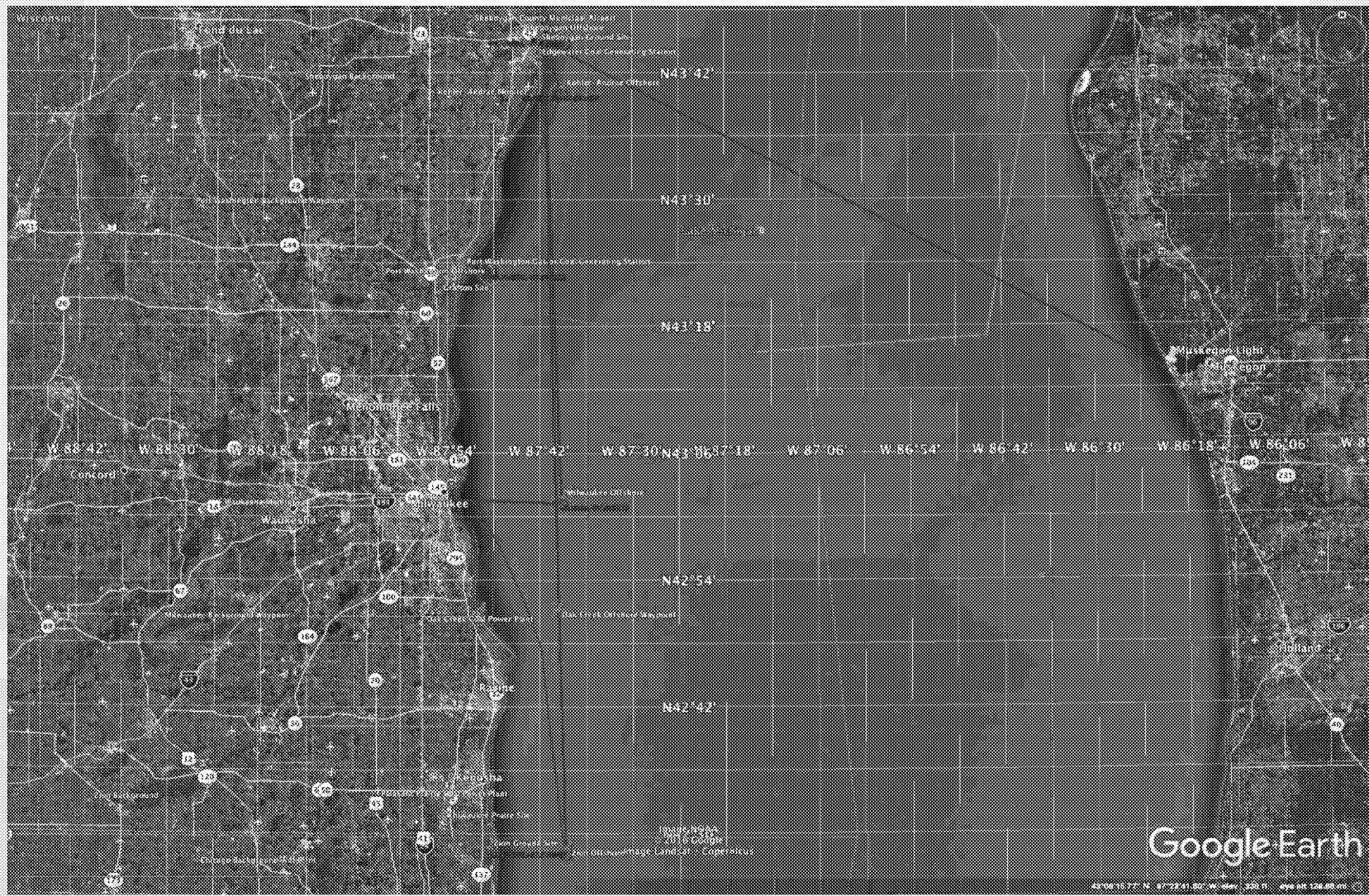


The NOAA Great Lakes Environmental Research Laboratory (GLERL) will be providing the RV R5503 during June 2-22

- EPA Pandora, ceilometer, O3 measurements using tethered kite)
- Based out of Sheboygan, WI during deployment

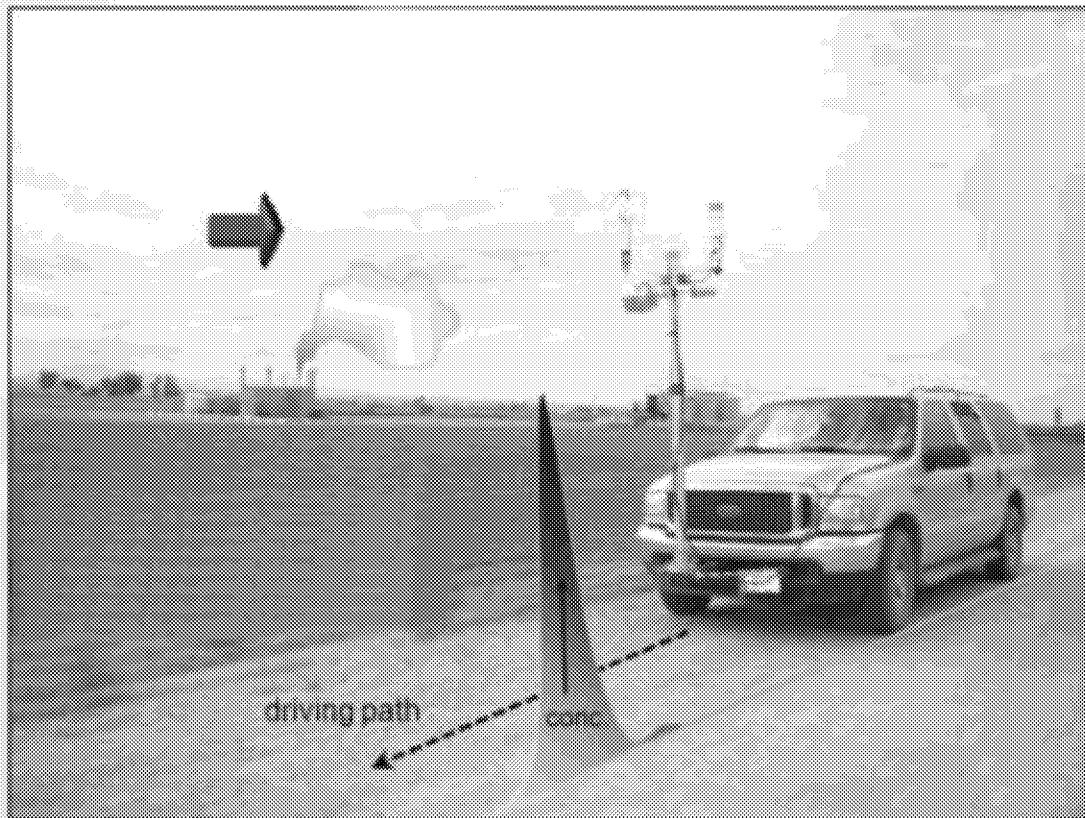


# LMOS NOAA GLERL Ship Tracks



# Mobile Van Measurements: EPA Region 5 Geospatial Measurement of Air Pollution (GMAP)

- GMAP has an integrated Differential Ultra Violet Absorption Spectroscopy (DUVAS) that can provide high frequency (1 second) measurements while moving or parked.



- Will be deployed during high ozone events to measure coastal and inland ozone gradients during LMOS

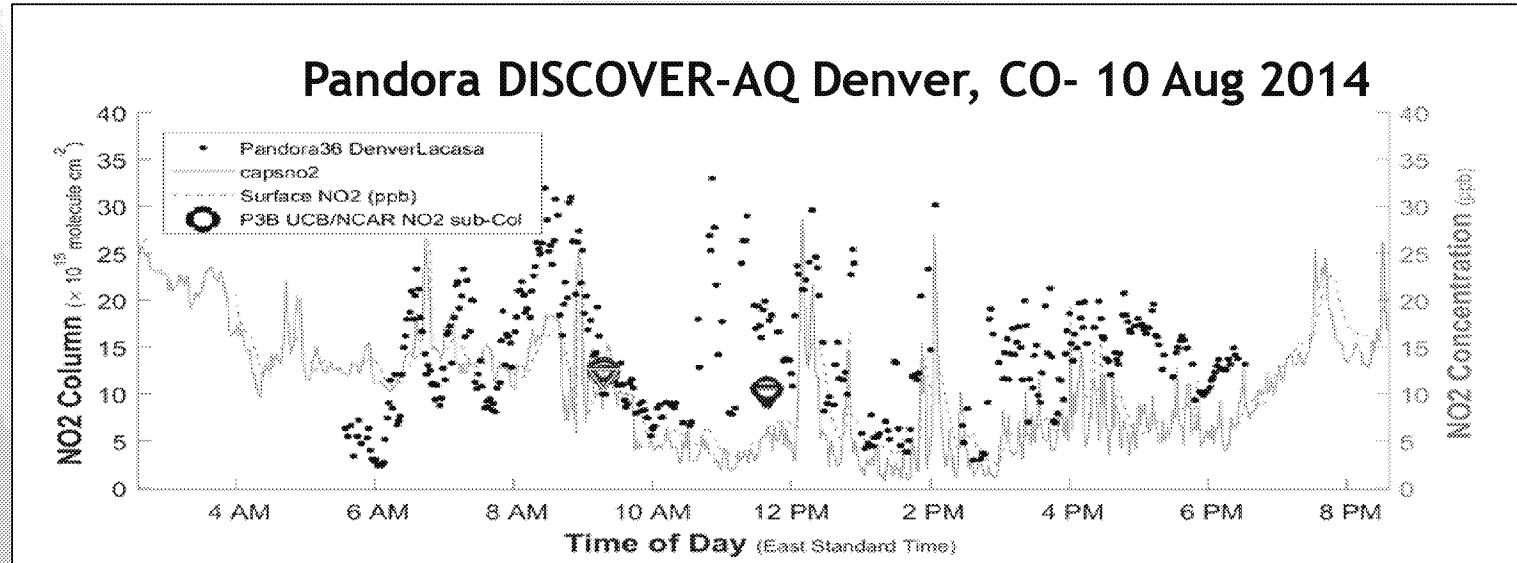
# EPA GMAP: Zion Inland Gradient route (light purple)



# Pandora Ground-Based Spectrometer



- Solar source spectrometer (280 - 525 nm: 0.6 nm resolution) - column NO<sub>2</sub>, O<sub>3</sub>, HCHO, and SO<sub>2</sub> every 80 second.
- Column NO<sub>2</sub>/HCHO ratios to assess role of formaldehyde in ozone formation in an urban and downwind environment.
- Deployed with ceilometers at Milwaukee, Sheboygan, Haven (WI), Zion, and NOAA Research Vessel



# Airborne Measurements: NASA GeoTASO and EPRI - Scientific Aviation

NASA Beechcraft UC-12 instrument Geostationary Trace gas and Aerosol Sensor Optimization (GeoTASO). GeoTASO is a UV-Vis Spectrometer that is used to retrieve column NO<sub>2</sub>, HCHO, and aerosols.

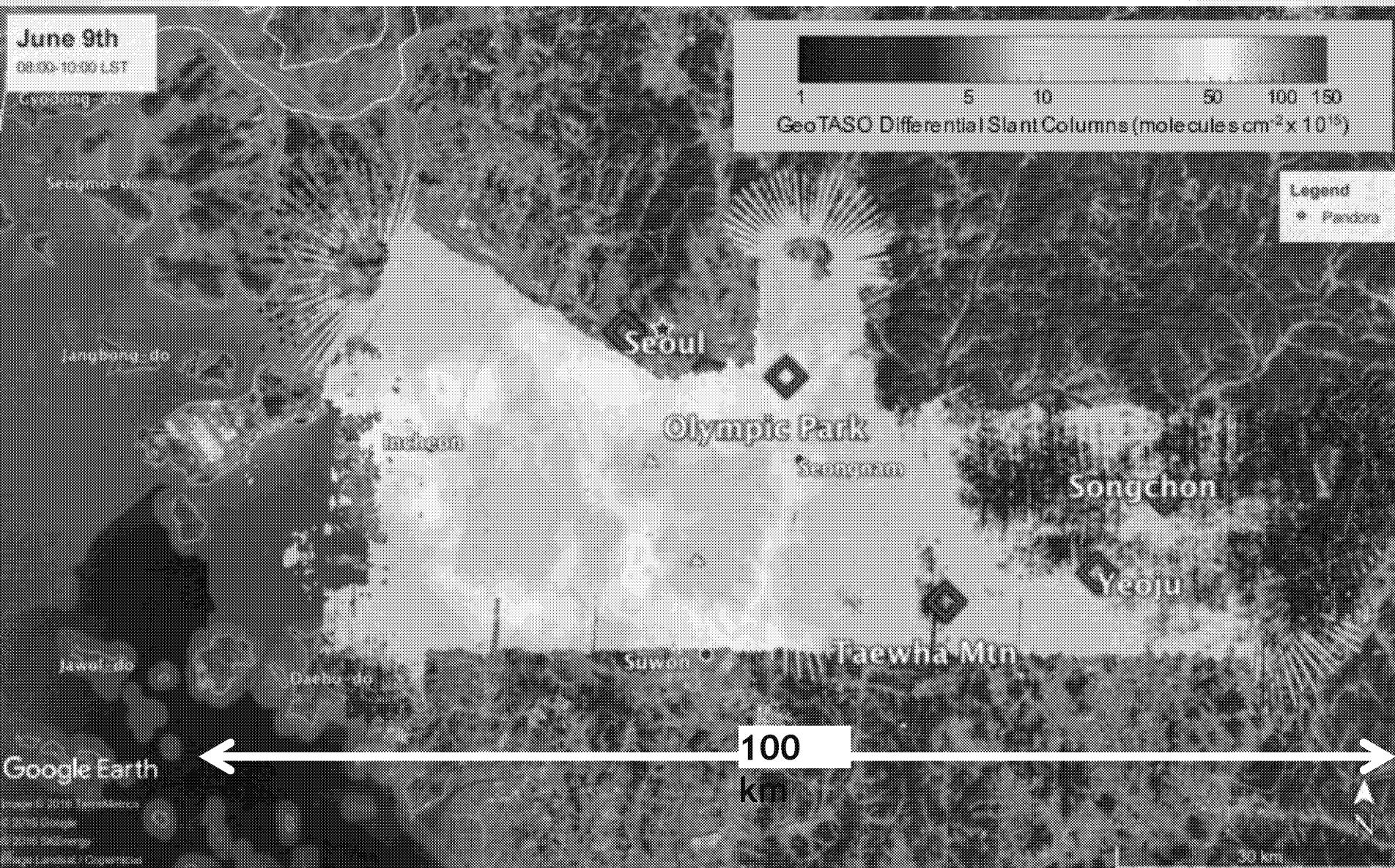


**Scientific Aviation\*** Mooney airplane equipped with meteorological, O<sub>3</sub> and NO<sub>2</sub> measurements. Spirals over key ground sites and measurements within the boundary layer over land and water.

\*Funded by Electric Power Research Institute (EPRI)

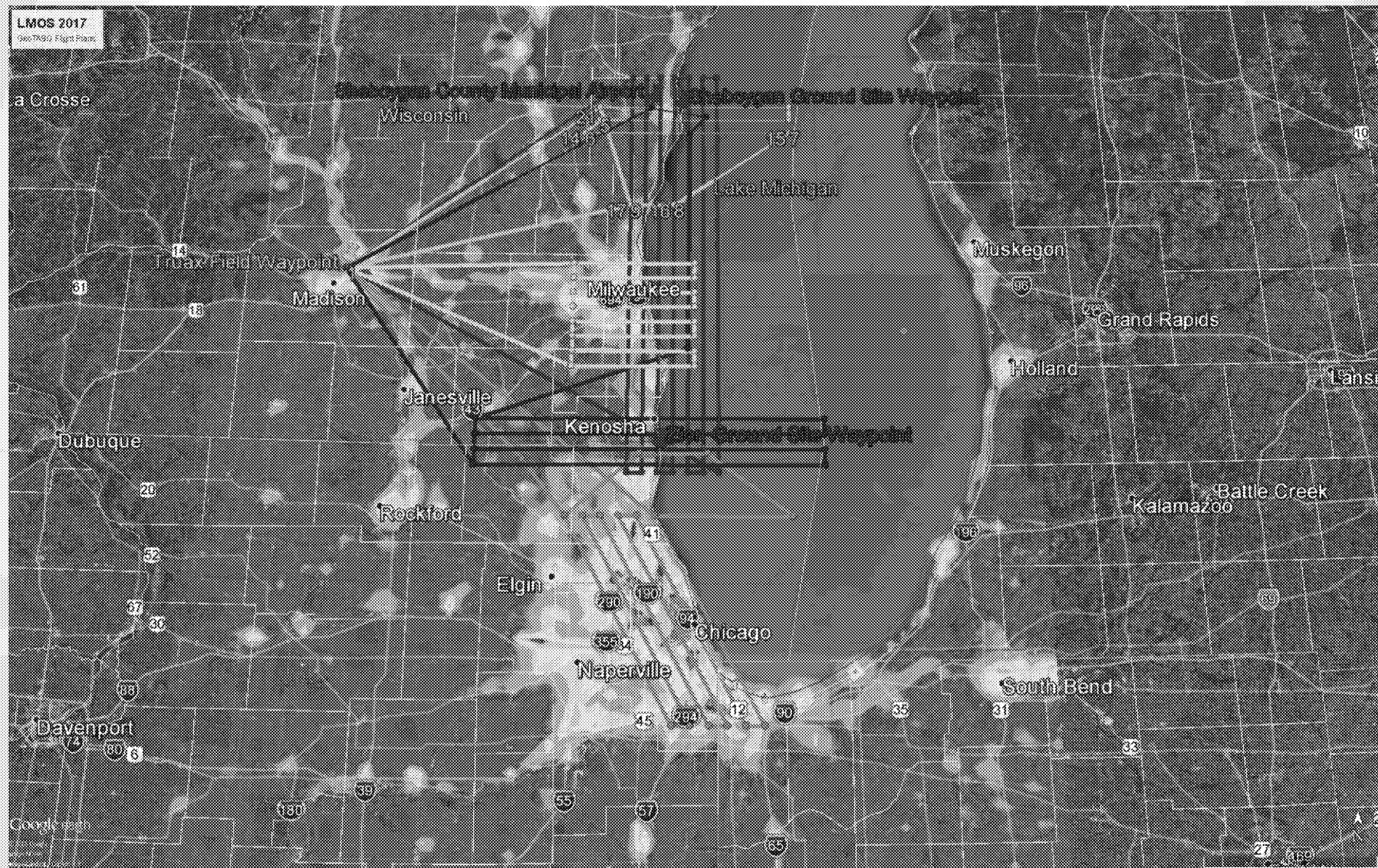
GeoTASO Quick-look differential slant column NO<sub>2</sub> - Seoul, Korea, 2016/06/09

*Images courtesy Laura Judd/NASA LaRC and Scott Janz/NASA GSFC*

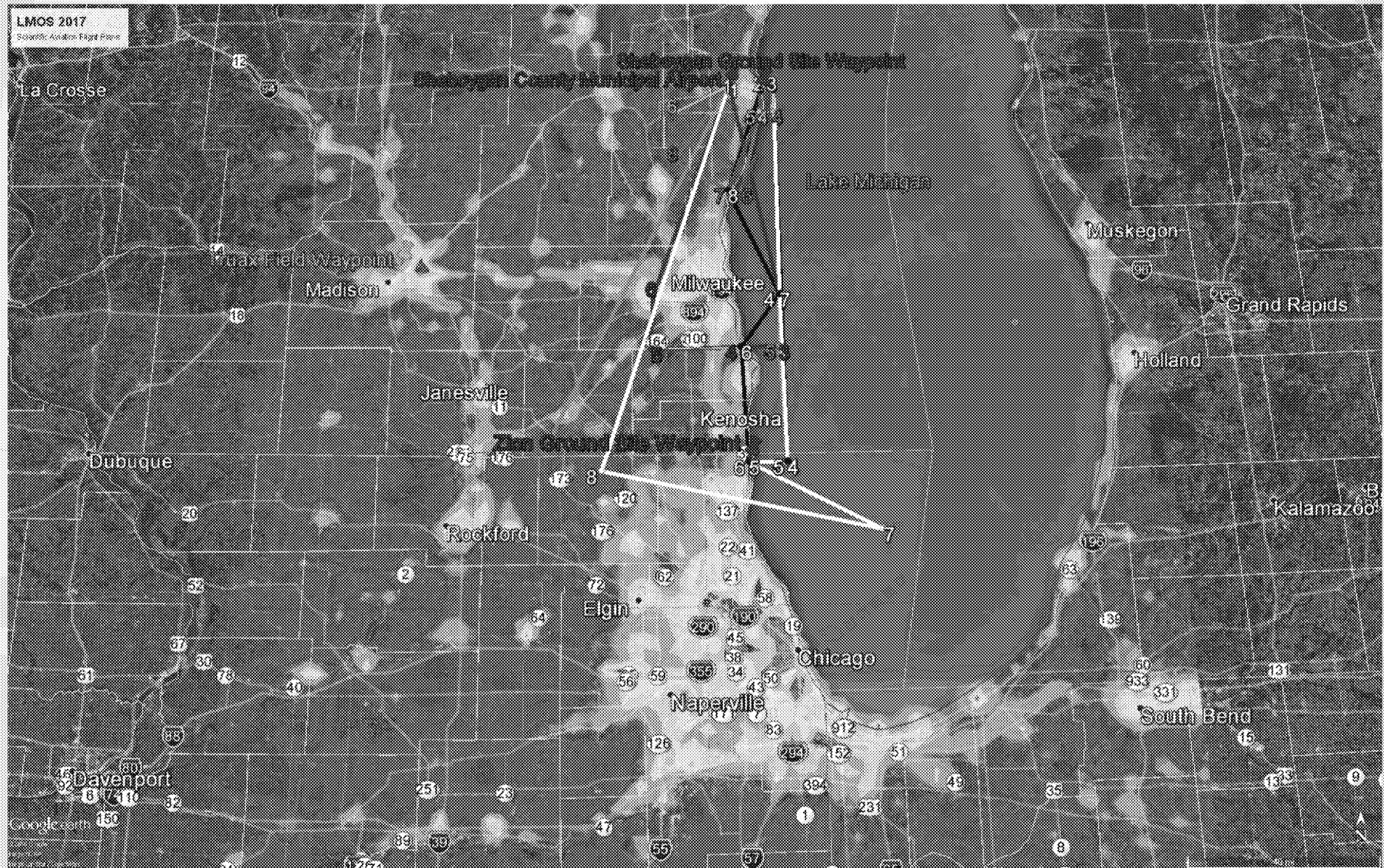


Data retrieved at approx. 250m x 250m horizontal resolution

# LMOS NASA GeoTASO Flight Tracks



# LMOS Scientific Aviation Flight Tracks



# LMOS Forecasting Support

## Daily 8:00am flight planning meeting

- Wisconsin DNR
  - Daily Ozone forecast
- NWS Sullivan (via email)
  - Daily (6:30am/3:30pm) met briefings
- Iowa 4km WRF-Chem
- NOAA 4km Met/Trajectory Model

